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ABSTRACT

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Running head: THE EFFECTS OF FLASH CARD USE

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The Effects of Flash Card Use on Students' Comprehension of Chemistry Vocabulary

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Abstract

This study investigated the effects of flash card use on students' comprehension of chemistry vocabulary. Participants of the study were students (N=70) from three 10th grade chemistry classes. The study utilized a pretest, treatment, posttest with control group design. The study lasted for 12 weeks. Results from Dependent t test indicated that all 3 classes made significantly more gain in chemistry terminology comprehension; analysis with the ANCOVA test showed that only 1 experimental class (out of 2 experimental classes) made significantly more gain than the control class did. The findings suggest that flash cards can be used to effectively help teachers teach, students learn and comprehend chemistry vocabulary.

The Effects of Flash Card Use on Students' Comprehension of Chemistry Vocabulary

Flash cards have been with us for a long time in the process of teaching and learning. In the language learning area, flash cards have been utilized in schools for a variety of purposes: to teach names and sounds of the letters of the alphabet (Young, Hecimovic, & Salzberg, 1983), sight words (Heron, Heward, Cooke, & Hill, 1983), and object labels (Olenick & Pear, 1980); to improve word recognition of poor readers (Culyer, 1988); to teach students to practice on vocabulary development, completion drills in the learning of foreign language (Ervin, 1988); flash cards have been applied in teaching English as second language (Hart, 1982); they have been used for second language practice – a variety of items are contained in the cards, such as tenses, sentence patterns, phrasal verbs, prepositions, articles or conditionals (Palka (1988). Flash cards have also been applied in the mathematics instructions: Hawkes (1983) introduced eight ways to use flash cards in mathematics instruction. Commercial flash cards designed for mathematics learning are available in the market (Frank Schaffer Publications, 1997; Ideal School Supply, 1990;). Software-based flash cards are now being used for helping students understand basic mathematics concepts (Maverick Software Inc., 1994). In addition, flash cards have been adopted to teach economics by classroom teachers in grades K-8 (Sandra Schurr Publications,1978), and to teach musical symbols (Siegel, 1971).

Even though flash cards have been used in schools in many different ways for a long time, research literature on the effects of flash card applications on learning is limited, which covers only the language and mathematics area. In the language area, a small number of studies are available. In one investigation on flash cards, Ehri and Roberts (1979) studied whether first

graders learn printed words better in contexts or in isolation. Post-test scores indicated that context-trained children learned more about the semantic identities of printed words, while flash card-trained children could read the words faster and learned more about orthographic forms. In a study that compared "a constant time-delay technique for identifying words" with "using the flash cards to identify words technique" (which allowed errors to occur in teaching trainable mentally impaired students to identify sight-words), Palmer (1990) found that the 4-second-delay group made significant fewer errors in word identification. However, no differences were observed in the number of words learned or in word retention after a one-week interim. In another study that involved the use of flash cards, the effects of three instructional conditions were compared: teaching community-referenced sight words and phrases with videotape in the school setting; teaching the sight words with flash cards in the school setting; or teaching the sight words with the natural signs in the community to adolescents with mild and moderate mental retardation (Cuvo & Klatt, 1992). The results indicated rapid acquisition of the community-referenced sight words in all three training conditions and generalization from the flash cards and videotape conditions to the community sites. These studies show that flash card use does contribute positively to language learning.

A body of literature includes studies on flash card use in the mathematics instruction area. In a search for the optimal methods for training Navy personnel who had achieved marginal scores on military selection tests, Main (1970) reported that the flash card instruction methods were adapted to teach basic math operations. The results of the study indicated that flash card instruction did not result in significantly higher performance gains of the participating Navy personnel. Main's conclusion was that applying the flash card methods to the relatively wide of

range of content complexity was not effective. In an investigation that compared the effects of the "teacher only flash card daily drill method" with the "teacher plus paraprofessional daily flash card drill method" in teaching multiplication facts to students with learning disabilities, Gibb (1994) found that all students in the teacher/paraprofessional flash card drill condition reached criterion, whereas only one student reached criterion in the teacher only flash card condition. Students in the teacher/paraprofessional condition had more average daily correct responses. Even though the main purpose of the study was to compare the effect of "teacher only" versus that by "teacher plus paraprofessional" in the flash card drill, flash card use should be considered to be a contributing variable in the learning results of the participating students. With regard to the efficacy of flash card instruction for teaching number facts to elementary school students with learning disabilities, Van Houten and Rolider (1989) conducted four experiments to assess the influence of several variables on children's acquisition of number facts during one-on-one tutor-tutee flash card instruction. The results of these experiments showed that a higher percentage of correct responses occurred, the students reached the criterion in less than half the time when the treatment package was in effect. This body of literature seems to show that teaching adult students with flash cards to learn mathematics was not effective. However, it was effective to use flash cards to help children learn mathematics.

As the above brief literature review indicated, research on the effectiveness of flash card use in the teaching and learning process is limited. Whether flash cards can be used to positively facilitate teaching and learning in subject areas other than language and mathematics remains to be studied. The purpose of the study was to investigate the effects of flash card use on students' comprehension of chemistry vocabulary.

Method

Participants

The participants of the study were 10th grade students (N=70) from 3 chemistry classes (first time chemistry students) of a large suburban high school in northern Illinois. Class A was composed of 26 students (15 females, 11 males); Class B had 22 students (15 females, 7 males); in Class C there were 22 students (8 females, 14 males). There were 2,900 students in the school. The majority of the students were Caucasian, and a small percentage of them were Hispanic and African-American. These students came from lower middle to upper income families. Approximately 80% of the school's graduates pursue higher education or trade school education.

The participant teacher (female, age in the twenties) was certified to teach chemistry, and had 2 years of teaching experience. This teacher taught the chemistry course to all 3 classes.

Procedure & Design

The study utilized a pretest, treatment, posttest with control group design (2 classes in experiment, 1 class as control). Class A and Class C became the experimental group, and Class B became the control group, which was decided through a random drawing. The data of the study were collected through two stages.

During the first stage (or baseline stage) data collection, all the students were directed by their teacher to write out the chemistry vocabulary and the related definitions from the lessons of the first chapter of their textbook, one lesson a time. The students were told to use the terms and definitions as study material for vocabulary quizzes. All the students were allocated 10 minutes at the end of each class period (a 50-minute class period) to study the vocabulary of the lessons in the first chapter. This so-called "write-out and study" process lasted for 6 weeks. During this

period, the students received three vocabulary quizzes, which measured students' comprehension of the chemistry vocabulary. A test (also called the first test) was given to all 3 classes by the end of 6th week. The test scores of the students in the 3 classes were recorded by the teacher.

During the second stage of data collection, Class A and C began to use flash cards to study. Class B continued to use the standard "write-out and study" method. For the treatment group, students in Class A and Class C began to write the vocabulary words of the lessons of Chapter 2 of the textbook on flash cards, one lesson a time. As directed by the teacher, the students wrote the vocabulary words on the front of the cards and the corresponding definitions on the back of the cards. In actual practice or study, the students individually were to look at the front of a card, and try to define the term. The same method was used for every card. After the first day of learning those terms, they were directed by the teacher to work with a partner: One student showed the front of a card to the other student, the other student provided definition in return. They would also switch roles. During this time, the teacher would move around in the classroom to see that all students were on task.

During this second stage, all 3 classes were allocated 10 minutes (at the end of the class periods) to study the chemistry vocabulary words, 3 times a week, for 6 weeks. During the same time, all of them received 3 quizzes designed by the teacher for the second chapter. A test was given to all 3 classes by the end of the 6th week. The test scores of the all the students were recorded by the teacher.

Instrument

The quizzes used in this study were created by the teacher. All the vocabulary words were selected from the students' textbook--ChemCom (American Chemical Society, 1993), which

were also accessible to all the students. The quizzes required that the students match the vocabulary words with correct definitions. One quiz was given per 1 and 1/2 weeks. Like the quizzes in content and format, the two tests were administered at the end of each chapter (or after 6 weeks); the test vocabulary were selected from the lessons of each chapter.

For data analysis, the raw scores of the first test were compared with those of the second test of each class for within-class effect analysis via the Dependent t Test. The test results were also analyzed via the ANCOVA test for between-class effect comparisons. The test scores of Class A were compared with those of Class B; the test scores of Class C were compared with those of Class B.

Results

As the results from the Dependent t Test indicated, both the treatment classes and the control class significantly improved in their comprehension of chemistry vocabulary. See Table 1. Results from ANCOVA analysis showed that in terms of the academic gain in comprehension of chemistry vocabulary, a significant difference was found between Class A and Class B in favor of Class A; no difference was found between Class C and Class B. See Table 2.

Discussion

With the present design, the data collected during the first stage of this study provide a strong basis for covariance analysis. The results from the first test (used as a pretest in data analysis) were the learning outcomes of all the students in the 3 classes after 6 weeks of training in the "write-out and study" approach. These data actually show whether the 3 classes were equal in comprehension of chemistry vocabulary. This type of information constitutes a relatively high quality covariate, which provides a sound basis for analysis of covariance. In fact, the data took 6

weeks to establish, which helps reduce nuisance factors or chance errors to a great extent. From this perspective, it is safe to say that the pretest data of this study help make the design to be relatively stronger than the usual design in the form of "pretest, treatment, posttest with control group design," and the data from the latter design are relatively weaker in that they may carry more nuisance factors.

The flash card training approach used in this study does carry a certain degree of intensity in the learning or training process as described in the Method section of this article. This intensity factor may have played an important role in the learning outcomes of those participating students. While there is no evidence for the authors to claim that the flash card training approach is better than the standard "write-out and study" approach in terms of learning outcome, it is reasonable to say that the flash card use approach applied in this study can be used as an effective training/learning method for high school teachers and students in chemistry study. Moreover, since empirical evidence on the efficacy of the flash card use is scarce on the whole as shown in the literature, it is important to further study the effects of flash card use, particularly in other areas of science subjects: biology, physics, computer science and so forth, which will certainly contribute to expanding the limited existing literature.

Conclusion

The question on whether the flash card use approach as practiced by the participating students and teacher in this study was effective has been investigated for 12 weeks. Results from data analyses indicated that the flash card use approach can be applied effectively by high school teachers and students in chemistry study. Further studies on this approach are considered vitally necessary, especially in other areas of science subjects.

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Table 1

Results from Dependent t Test: Within-Class Effects

Class	Pretest Mean	Posttest Mean	df	t	p
A	70.77	83.62	25	-6.85	.000
B	72.05	79.77	21	-4.1	.000
C	76.64	82.96	21	-2.56	.018

Table 2

Results from ANCOVA: Between-Class Effects

Class*	Source	df	MS	F	p
	Pretest**	1	2223.74	54.26	.000
A vs. B	Class	1	241.79	5.9	.019
	Error	45	40.98		
	Pretest	1	2667.6	40.49	.000
C vs. B	Class	1	3.39	.05	.82
	Error	41	65.88		

* Class = Comparisons between classes.

** Pretest = Correlation between pretest and posttest.